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(54) **POOL CLEANING ROBOT**

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CPC ***E04H 4/1654*** (2013.01); ***E04H 4/1636*** (2013.01)

(58) **Field of Classification Search**
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USPC 15/1.7; 210/167.15, 167.16, 167.17, 210/416.2
See application file for complete search history.

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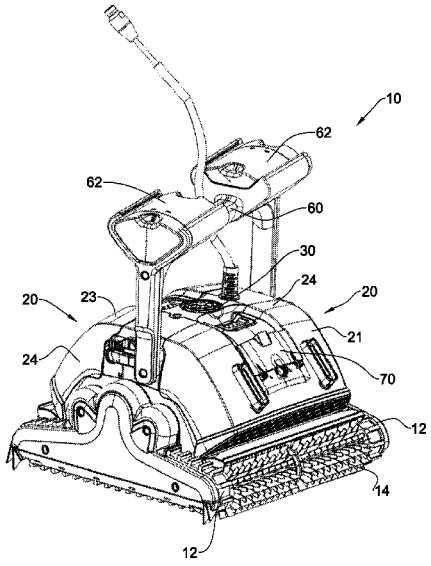
(57) **ABSTRACT**

A pool cleaning robot comprising: a housing; an impeller and a motor; at least one filter compartment configured for accommodating a filter unit therein; an impeller outlet formed in a housing top surface; at least one additional outlet other than the impeller outlet configured for being fluidly connected to an external suction and filtering system; at least one bottom inlet formed in said housing bottom configured for a first fluid communication with the impeller outlet via said filter unit, thereby defining a first fluid path; and at least one bottom inlet formed in said housing bottom configured for a second fluid communication with said additional outlet via a second fluid path at least partially different from the first fluid path, said second fluid path constituting a part of an external suction and filtering fluid path created when said additional outlet is fluidly connected to an external suction and filtering system.

16 Claims, 10 Drawing Sheets



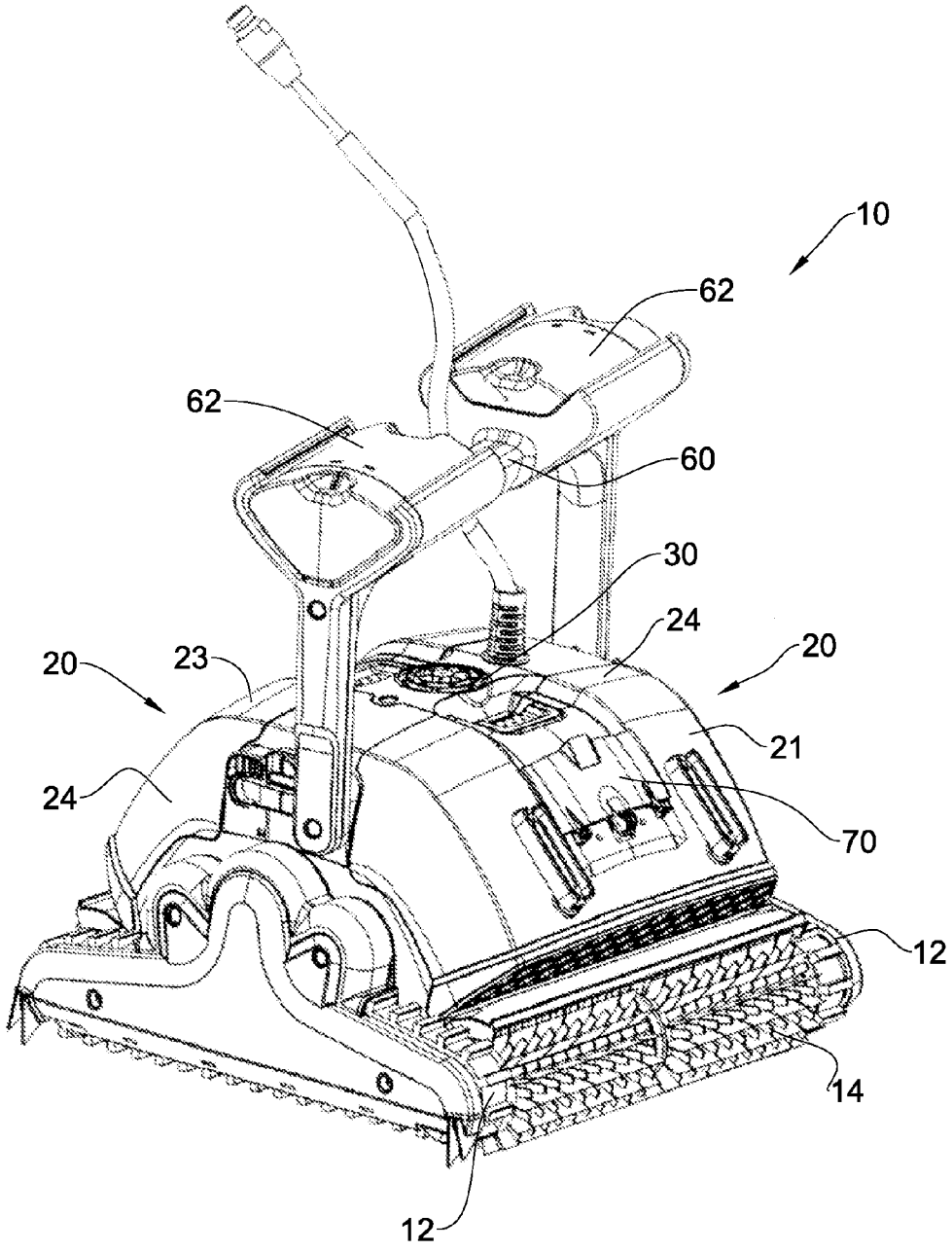


Fig. 1

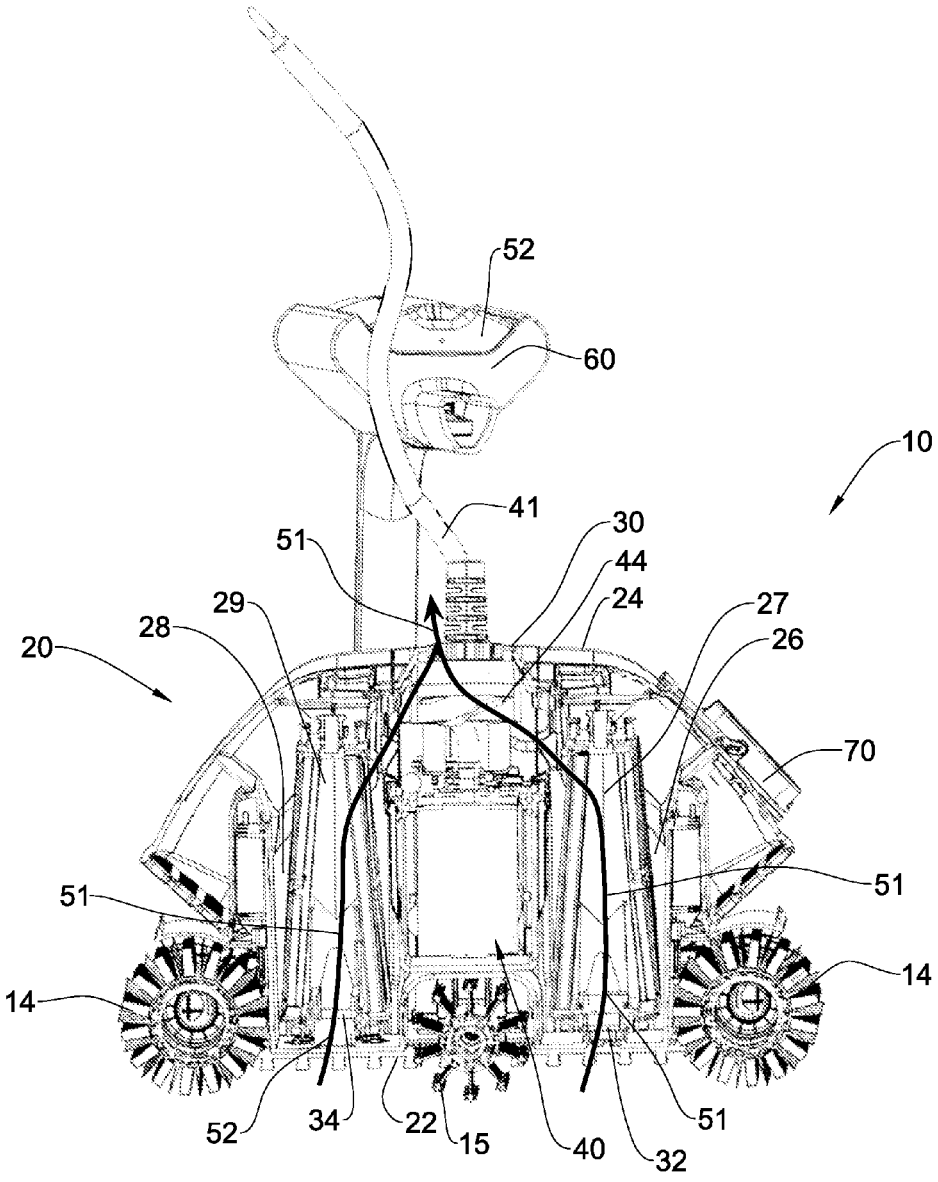

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Fig. 2

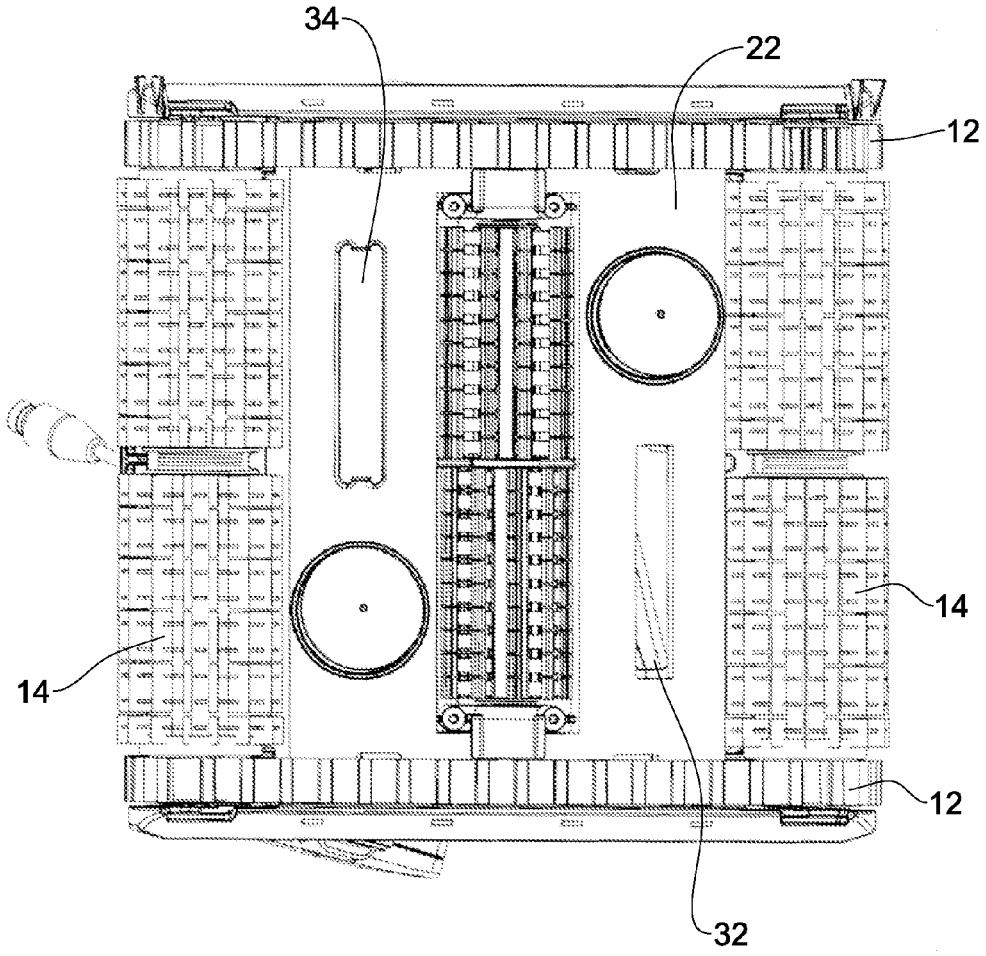

Fig. 3

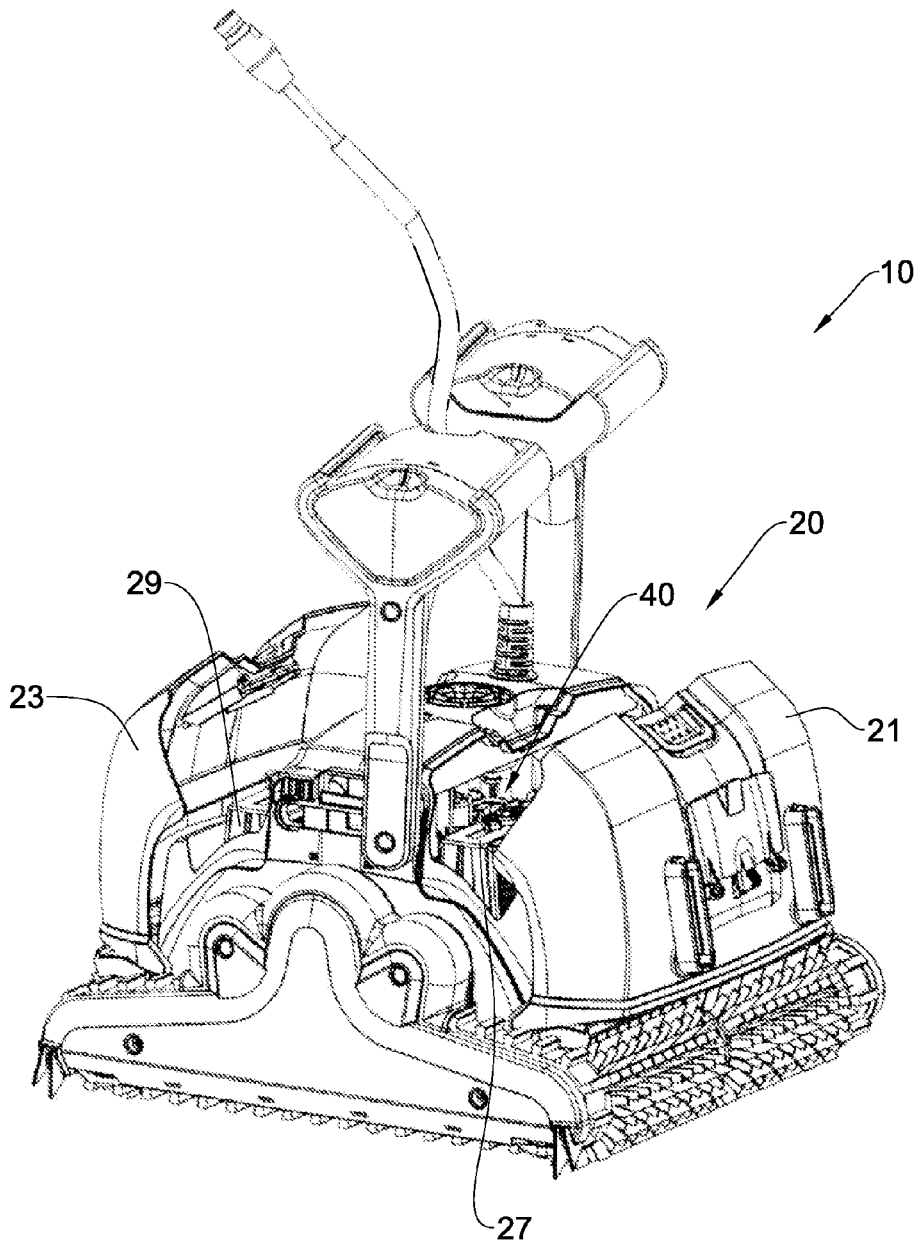

Fig. 4

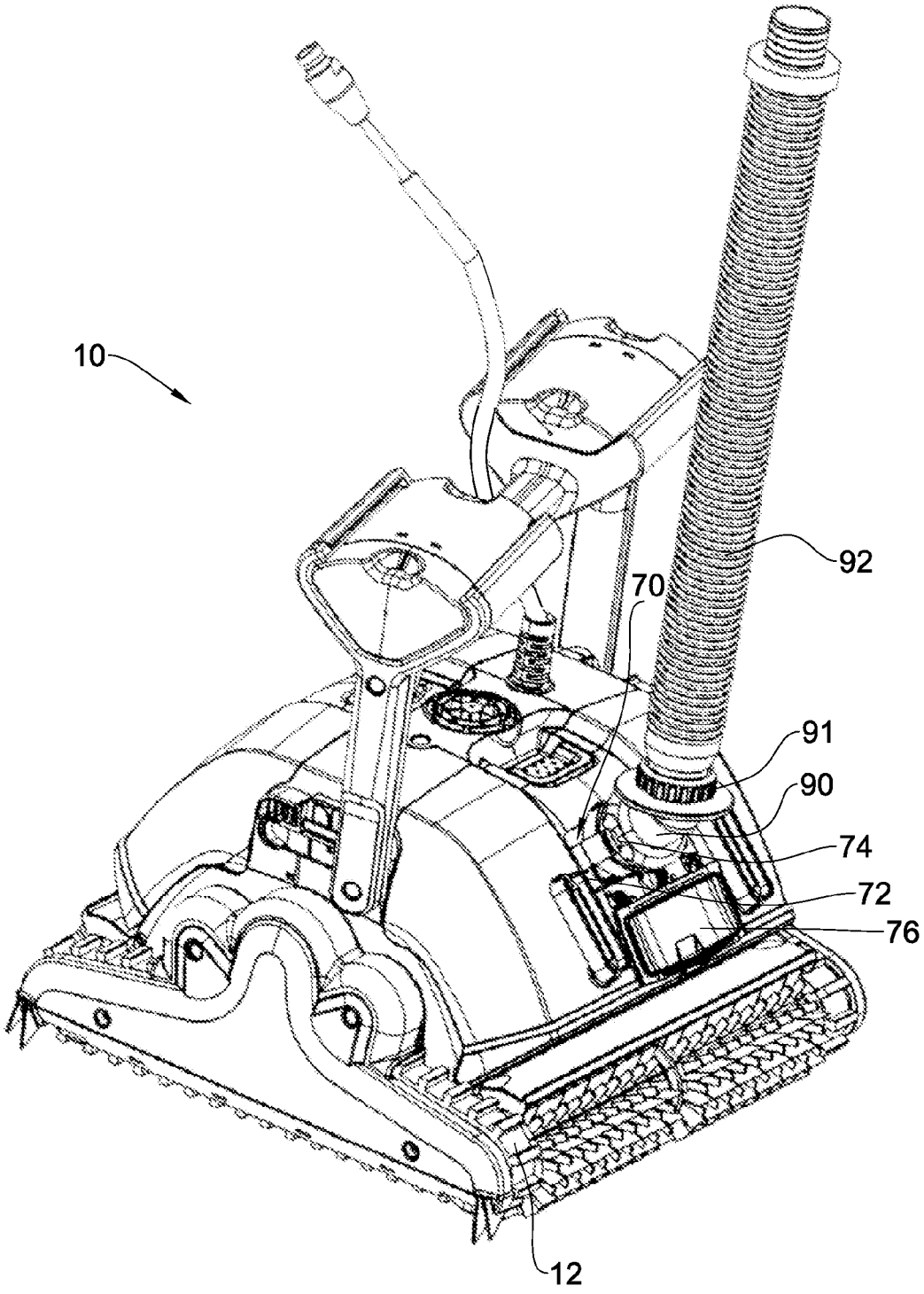

Fig. 5

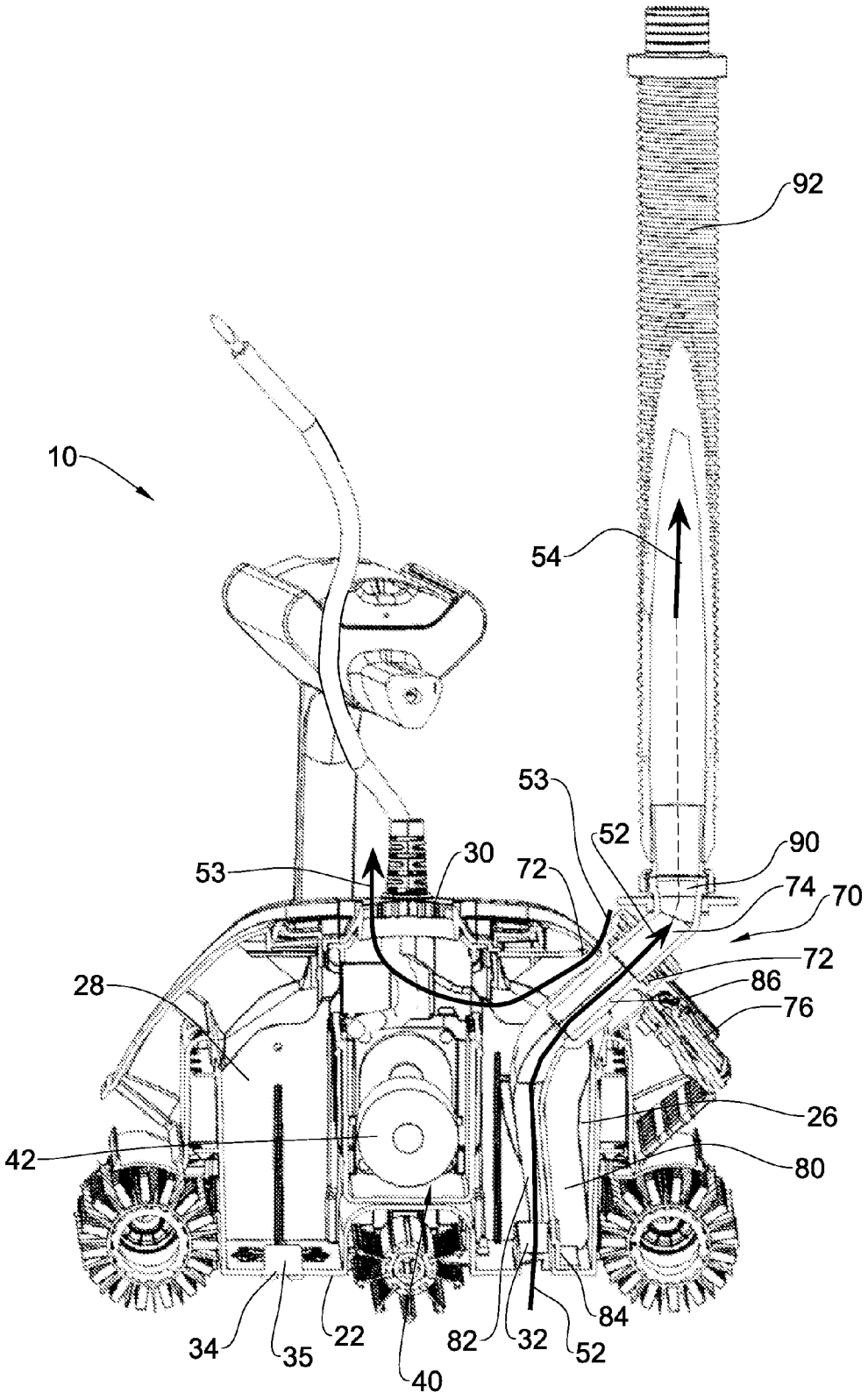
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Fig. 6

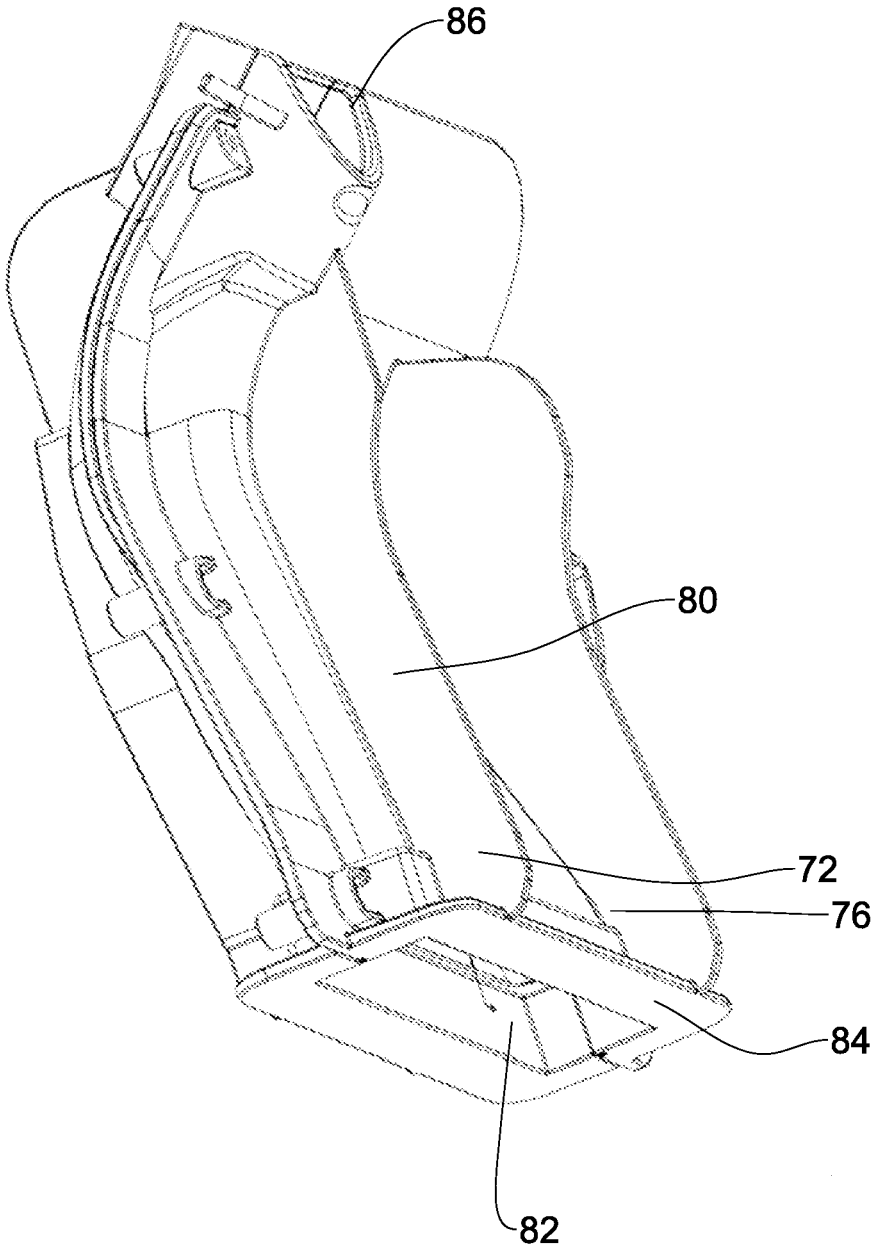

Fig. 7

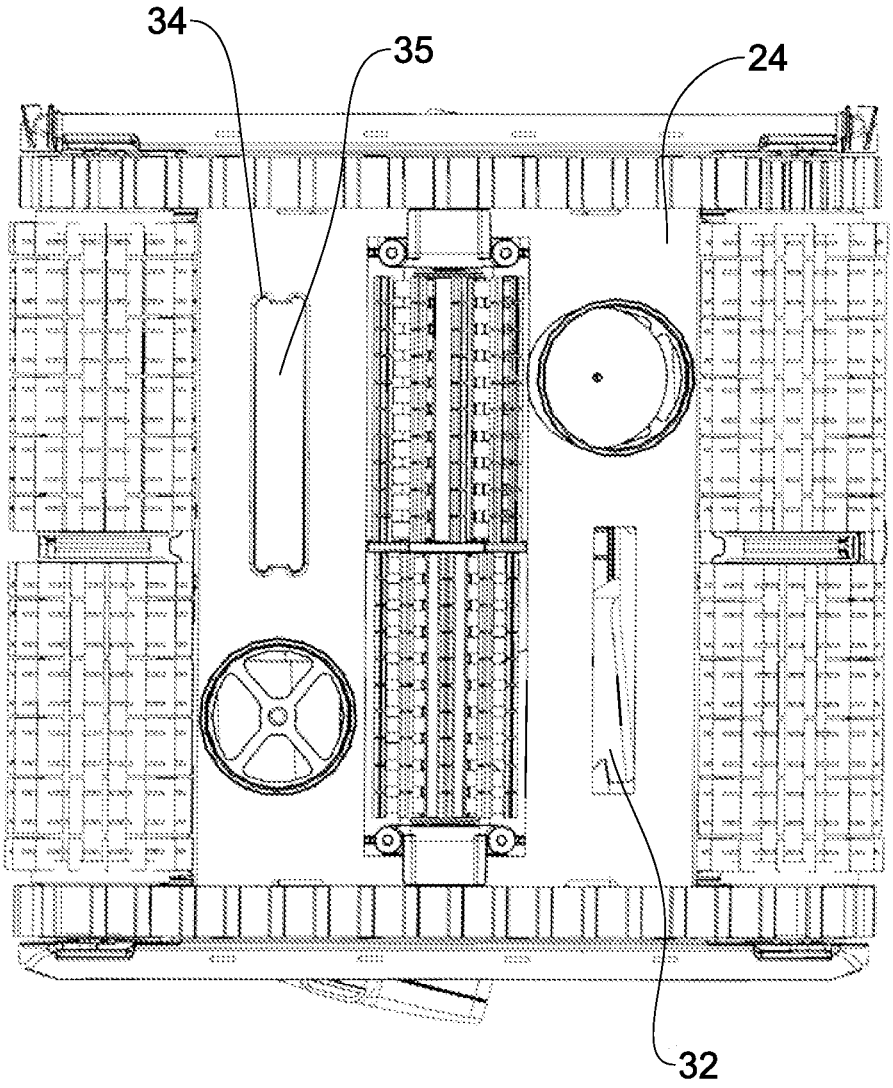

Fig. 8

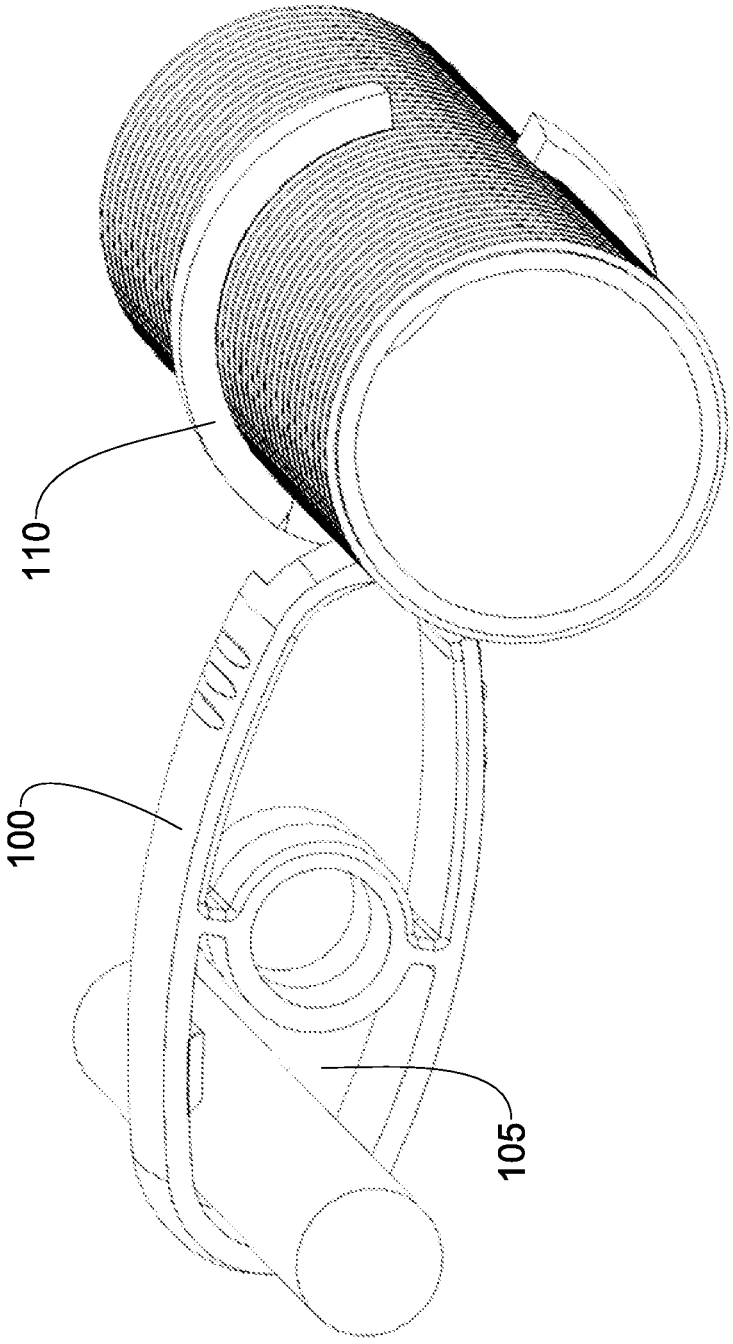

Fig. 9

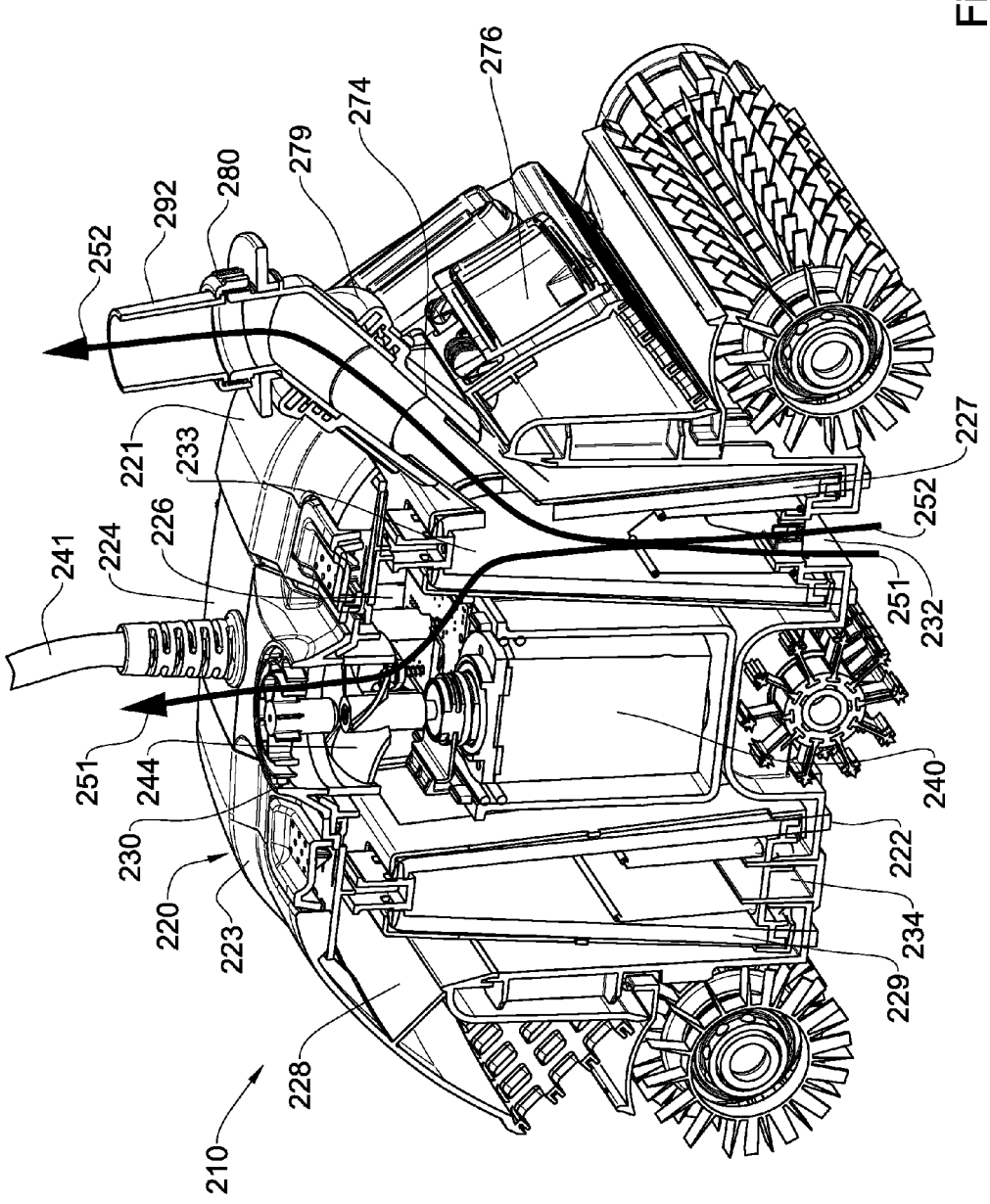
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Fig. 10

POOL CLEANING ROBOT

RELATED APPLICATIONS

This application claims priority from Israeli Patent Application serial number 215115, titled "POOL CLEANING ROBOT", filing date Sep. 13, 2011, which is incorporated herein by reference.

TECHNICAL FIELD

This invention relates to devices for cleaning swimming pools, basins, and the like. More particularly, the invention relates to an electric robot being able to clean the swimming pool automatically.

BACKGROUND DESCRIPTION

Different types of pool cleaning robots exist, and particularly known are cleaning robots whose suction is connected to the suction device of the pool filtration system and depends on the latter, and cleaning robots equipped with a pump that is independent in relation to the pool filtration system.

A robot that uses the filtration system of the pool is disclosed for example in US patent application US2009/307854. A robot that is equipped with a pump and has an internal filtration system is disclosed for example in US patent application US2007/028405.

There is also one example of a pool cleaning robot that is marketed under the name WEDA B680. This robot has an internal pump and a filter bag which is connectable to its impeller outlet. This robot can also be connected to an external filtration system such as the filtration system of the pool by removing the filter bag, and directing the impeller outlet to be filtered by the external filtration system.

SUMMARY OF THE PRESENTLY DISCLOSED SUBJECT MATTER

The presently disclosed subject matter provides a pool cleaning robot which can filter the water of the pool by using of an internal or an external suction and filtering system, according to different needs and parameters (e.g., the type of the debris in the water, time, and availability of the filtering systems).

In accordance with one aspect of the presently disclosed subject matter, there is provided a pool cleaning robot, comprising: a housing having a housing bottom and a housing top surface; an impeller and a motor configured to operate the impeller, both mounted within the housing; at least one filter compartment formed within the housing configured for accommodating a filter unit therein; an impeller outlet formed in the housing top surface; at least one additional outlet other than the impeller outlet formed in the housing top surface and configured for being fluidly connected to an external suction and filtering system; at least one bottom inlet formed in the housing bottom configured for a first fluid communication with the impeller outlet via the filter unit, thereby defining a first fluid path; and at least one bottom inlet formed in the housing bottom configured for a second fluid communication with the additional outlet via a second fluid path at least partially different from the first fluid path. The second fluid path constitutes a part of an external suction and filtering fluid path created when the additional outlet is fluidly connected to an external suction and filtering system.

The term 'external suction and filtering system' refers hereinafter to any known in the system which is able to pump fluid and filter it. This system can be, for example, a filtering system of a swimming pool (e.g., standard pool filtering systems, biological filtering system), or any other filtering system located outside the robot. According to the presently disclosed subject matter, the external suction and filtering system can be configured to pump water with debris via the robot, and filter this water. The external suction and filtering system can be constructed of two separate systems: a suction system and a filtering system which can be fluidly connected to each other.

The bottom inlet of the first fluid path can constitute the bottom inlet of the second fluid path. The robot can further comprise an arrangement for selecting or mixing between the first fluid communication and the second fluid communication.

The filter compartment can be configured to accommodate an adapter unit having an interior portion which constitutes a part of the second fluid path.

The interior portion of the adapter unit can be disposed between a first and a second end of the adapter unit. The first end of the adapter unit can be configured for fluidly communicating with the bottom inlet of the second fluid path, and the second end of the adapter unit can be configured for fluidly communicating with the additional outlet.

The arrangement for selecting or mixing between the first fluid communication and the second fluid communication can be provided by the filter unit and the adapter unit being interchangeably accommodated within the filter compartment. The arrangement can further provided by the additional outlet being configured for being opened and closed for allowing and preventing the second fluid communication, respectively. The robot can further comprise a hose adapter configured for fluidly connecting the additional outlet to a hose connectable to the external suction and filtering system. The external suction and filtering fluid path can further be defined by this hose. The hose adapter can include a swivel mechanism configured for preventing swivel of said hose around itself.

The robot can be operated by an electric supply source via an electric cable. The robot can comprise at least one holder configured for holding the electric cable and the hose in proximity to each other and preventing their swivel around each other. The holder can comprise: an aperture for allowing insertion of said cable therethrough and free rotation of said cable therein; and a grasper configured for detachably attaching to the hose.

The robot can further comprise at least one additional inlet formed in the housing top surface and configured for a third fluid communication with the impeller outlet, thereby defining a third fluid path. The third fluid communication can be configured to generate a thrust force that biases the housing toward a pool surface which the housing bottom faces during operation of the robot.

The first fluid communication can also be configured to generate a thrust force that biases the housing toward a pool surface which the housing bottom faces during operation of the robot. The robot is configured for climbing of a sidewall of the pool during operation of the robot via the first fluid path, and during operation of the robot via a combination of the second and the third fluid paths, when the biasing contributes to the robot to be in contact with the sidewall of the pool.

The robot can be configured to be operated via the second and the third fluid communications, simultaneously. The arrangement for selecting or mixing between the first and a combination of the second with the third fluid paths can be

provided by the additional inlet which is configured for being opened and closed for allowing and preventing said third fluid communication, respectively.

The additional inlet and outlet can be disposed at a common opening formed within the housing top surface.

The common opening can comprise a door configured for allowing and preventing the second and third fluid communication by being opened and closed, correspondingly. The additional inlet can be formed at the common opening around the additional outlet.

The bottom inlet of the first fluid path can constitute the bottom inlet of the second fluid path, and the filter unit can have a filter unit interior at least a part of which can be configured to constitute at least a part of the first and the second fluid paths, while the third fluid path is obstructed (if it exists).

The filter unit can comprise a filter unit opening configured to fluidly communicate between the filter interior and the additional outlet.

The fluid communication between the filter interior and the additional outlet can be configured to allow extraction of debris from the filter interior via the second fluid path.

The first and second fluid paths can be operative simultaneously, during the operation of the robot.

The first and second fluid paths can be operative independently from each other.

The robot can comprise a driving unit having at least one electric motor configured for moving the robot within the pool. The driving unit can be operated by an electric supply source, and can comprise a main controller configured to control the operation of the motor during operation of the robot via the first fluid path, and during operation of the robot via a combination of the second and the third fluid paths.

The at least one bottom inlet can constitute at least a first and a second bottom inlet, one of which is sealable for fluid communication by a sealing member when the second and third fluid communications are selected.

According to an additional aspect of the presently disclosed subject matter, there is provided a pool cleaning robot, comprising: a housing having a housing bottom and a housing top surface; an impeller and a motor configured to operate the impeller, both mounted within the housing; an impeller outlet formed in the housing top surface; at least one bottom inlet formed in the housing bottom configured for a first fluid communication with the impeller outlet via the filter unit, thereby defining a first fluid path; and at least one additional inlet formed in the housing top surface and configured for a third fluid communication with the impeller outlet, thereby defining a third fluid path. The first and the third fluid communications can be configured to generate a thrust force that biases the housing toward a pool surface which the housing bottom faces during operation of the robot.

According to an additional aspect of the presently disclosed subject matter, there is provided a pool cleaning robot, comprising: a housing having a housing bottom and a housing top surface; an impeller and a motor configured to operate the impeller, both mounted within the housing; a first and a second filter compartments formed within the housing, each configured for accommodating a filter unit therein; the motor being disposed between the first and second filter compartments; an impeller outlet formed in the housing top surface; an additional outlet other than the impeller outlet formed in the housing top surface proximal to the first filter compartment and configured for being fluidly connected to an external suction and filtering system; and a first and a second bottom inlets formed in the housing bottom, each configured to be in fluid communication with the first and the second filter compartments and configured for a first fluid communication with the impeller outlet via the filter units, thereby defining a first fluid path. The first bottom inlet can be configured for a second fluid communication with the additional outlet via a second fluid path at least partially different from the first fluid path. The second fluid path can constitute a part of an external suction and filtering fluid path created when the additional outlet is fluidly connected to an external suction and filtering system.

The robot can comprise an additional inlet formed in the housing top surface and configured for a third fluid communication with the impeller outlet, thereby defining a third fluid path. The third fluid communication can generate a thrust force that biases the housing toward a pool surface adjacent to the housing bottom. The first fluid communication can also generate a thrust force that biases the housing toward a pool surface adjacent to the housing bottom.

The robot can further comprise an arrangement for selecting or mixing between the first and a combination of the second with the third fluid communications. The arrangement can be provided by the additional outlet being configured for being opened and closed for allowing and preventing said second fluid communication, respectively.

The additional inlet and outlet can be disposed at a common opening formed within the housing top surface. The common opening can comprise a door configured for allowing and preventing the second and third fluid communications, by being opened and closed, correspondingly. The additional inlet can be formed at the common opening around the additional outlet.

The first filter compartment can be configured to accommodate an adapter unit having an interior portion which constitutes a part of the second fluid path.

The interior portion of the adapter unit can be disposed between a first and a second end of the adapter unit. The first end of the adapter unit can fluidly communicate with the first bottom inlet, and the second end of the adapter unit can fluidly communicate with the additional outlet.

The arrangement for selecting or mixing between the first fluid communication and the second fluid communication can be provided by the filter unit and the adapter unit being interchangeably accommodated within the filter compartment.

The robot can further comprise a hose adapter configured for fluidly connecting the additional outlet to a hose connectable to the external suction and filtering system. The hose adapter can include a swivel mechanism configured for preventing swivel of said hose around itself.

The robot can be operated by an electric supply source via an electric cable. The robot can comprise at least one holder configured for holding the electric cable and the hose in proximity to each other and preventing their swivel around each other. The holder can comprise: an aperture for allowing insertion of said cable therethrough and free rotation of said cable therein; and a grasper configured for detachably attaching to the hose.

According to an additional aspect of the presently disclosed subject matter, there is provided a kit for cleaning a pool, comprising a pool cleaning robot, an adapter unit, and a hose. The pool cleaning robot comprising: a housing having a housing bottom and a housing top surface; an impeller and a motor configured to operate the impeller, both mounted within the housing; at least one filter compartment formed within the housing configured for accommodating a filter unit and the configured for accommodating the adapter unit therein; an impeller outlet formed in the housing top surface; at least one additional outlet other than the impeller outlet

formed in the housing top surface and configured for being fluidly connected to an external suction and filtering system via the hose; at least one bottom inlet formed in the housing bottom configured for a first fluid communication with the impeller outlet via the filter unit, thereby defining a first fluid path; and at least one bottom inlet formed in the housing bottom configured for a second fluid communication with the additional outlet via a second fluid path at least partially different from the first fluid path and via the adapter unit, the second fluid path constituting a part of an external suction and filtering fluid path created when the additional outlet is fluidly connected to an external suction and filtering system via the hose.

According to an additional aspect of the presently disclosed subject matter, there is provided a pool cleaning robot being operated by an electric supply source via an electric cable and connected to an external suction and filtering system via a hose, comprising at least one holder configured for holding the electric cable and the hose in proximity to each other and preventing their swivel around each other.

The holder can comprise: an aperture for allowing insertion of the cable therethrough and free rotation of the cable therein; and a grasper configured for detachably attaching to the hose.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it can be carried out in practice, embodiments will now be described, by way of non-limiting examples only, with reference to the accompanying drawings, in which:

FIG. **1** schematically illustrates a perspective view of a pool cleaning robot according to the presently disclosed subject matter, when its internal filtering system can be used;

FIG. **2** schematically illustrates a cross-sectional view of a pool cleaning robot according to the presently disclosed subject matter, when its internal filtering system can be used;

FIG. **3** schematically illustrates a bottom view of a pool cleaning robot according to the presently disclosed subject matter, when its internal filtering system can be used;

FIG. **4** schematically illustrates a perspective view of a pool cleaning robot according to the presently disclosed subject matter, when its housing top surface is opened for extraction of filter unit therefrom;

FIG. **5** schematically illustrates a perspective view of a pool cleaning robot according to the presently disclosed subject matter, ready for connection or connected to an external suction and filtering system;

FIG. **6** schematically illustrates a cross-sectional view of a pool cleaning robot according to the presently disclosed subject matter, ready for connection or connected to an external suction and filtering system;

FIG. **7** schematically illustrates an adapter unit of a pool cleaning robot according to the presently disclosed subject matter;

FIG. **8** schematically illustrates a bottom view of a pool cleaning robot according to the presently disclosed subject matter, ready for connection or connected to an external suction and filtering system;

FIG. **9** schematically illustrates a perspective view of a holder configured holding an electric cable of the robot and a hose connected to the robot in proximity to each other; and

FIG. **10** schematically illustrates a perspective view of a pool cleaning robot configured for cleaning a pool by an internal filtering system and having an ability to provide extraction of debris collected therein by an external suction and filtering system.

DETAILED DESCRIPTION OF EXAMPLES

The presently disclosed subject matter discloses a pool cleaning robot which is configured for cleaning a surface and/or water of a pool by providing an ability to use one of two types of filtering systems: an internal filtering system and an external suction and filtering system. Each of these filtering systems has its own advantage over the other one, and can be chosen for cleaning the pool according to various circumstances such as the type and the amount of debris in the water, and the type of the pool (e.g., a regular pool, a biological pool). For example, if the pool has debris (e.g., leaves, parts of vegetation) that can at least partially obstruct an internal filter (which constitutes a part of the internal filtering system), the external suction and filtering system can be chosen. This can be important, for example in biological pools. Alternatively, when simple cleaning of the pool is needed, the use of the internal filtering system may be preferable. This type of filtering system may be more economical, less complicated, and much simpler for operation.

As illustrated in FIGS. **1** to **3**, there is provided a pool cleaning robot, which is generally indicated at **10**. The robot **10** of FIGS. **1** to **3** is configured to clean the pool by using an internal filter system, as it is explained below. The robot **10** comprises a housing **20** which has a housing bottom **22** and a housing top surface **24** having a first cover **21** and a second cover **23**, and a driving unit **40** having an impeller **44** which is connected to an impeller motor (not shown) that rotates the impeller in operation. The driving unit **40** also includes two motors **42** (shown in FIG. **6**) configured to move the robot within the swimming pool by rotating right and left movement belts **12**, correspondingly.

According to other example, the impeller motor and the motors **42** can be the same motor which uses transition system for simultaneously operating the impeller and the motors **42**.

The housing **20** also includes a first filter compartment **26** and a second filter compartment **28** formed therein, such that the driving unit **40** is disposed therebetween. As shown in FIG. **2**, each of the filter compartments **26** and **28** accommodates a first filter unit **27** and a second filter unit **29**, correspondingly. The first and the second filter units **27** and **29** constitute a part of the internal filtering system by filtering the pool's water which passes therethrough while being pumped by the impeller **44**. The filter units **27** and **29** are made of a rigid frame, and can be extracted from the robot **10** for cleaning, replacement, and for using the external suction and filtering system instead of the internal filtering system.

In addition, the robot **10** comprises a handle **60** which contains two floats **62** for maintaining a balanced position during use on a pool's floor, and a balanced position when cleaning at the waterline.

The driving unit **40** is sealably disposed within the housing **20**, and can be operated by being connected to an electric power source (not shown) via an electric cable **41**. The driving unit **40** also includes a main controller (not shown) which can be programmed to control the operation of the robot, and specifically the operation of the motor **42**. For example, the main controller can be programmed to perform scanning of the pool according to one of several algorithms.

The robot **10** further includes movement belts **12** which are driven by the motor **42**, two main brushes **14** and an auxiliary brush **15** therebetween all connected to the movement belts **12** and operable by the motor **42**, so that in operation, an

impeller motor of the driving unit **42** rotates the impeller **44** for generating suction of water from the robot **10** and simultaneously the motors **42** rotate the movement belts **12** and the main brushes **14** connected thereto.

The housing **10** further includes an impeller outlet **30** which is formed in the housing top surface **24**, and a first and second bottom inlets **32** and **34** which are formed in the housing bottom **22**. As shown in FIG. **3**, the first and the second bottom inlets **32** and **34** are in fluid communication with the first and the second filter compartments **26** and **28**, and with the first and the second filter units **27** and **29**, correspondingly. In the configuration of the robot **10** according to FIGS. **1** to **3**, in which the internal filtering system is used, the first and the second bottom inlets **32** and **34** are in a first fluid communication with the impeller outlet **30** via the first and the second filter units **27** and **29**, correspondingly, thereby defining a first fluid path **51** (shown in FIG. **2**).

During operation of the robot **10**, when the internal filtering system is used, the impeller **44** which is operated by the impeller motor, draws water and debris from the floor or sidewall of the pool via the first fluid path, i.e., from the first and the second water inlets **32** and **34** through the first and the second filters **27** and **29** towards the impeller outlet **30**. The clean water is expelled through the impeller outlet **30**. In addition to facilitating the cleaning of the pool, this process generates a thrust force that biases the robot **10** toward the surface of the pool. This thrust force keeps the robot proximal to the pool's surface to as to clean the pool's floor and to climb on the pool's wall and clean it. This operation is generally similar to the operation of known electrically powered robots, which have internal filtering system, such as the robots which are disclosed in US2009/0045110 and in US2010/0306931. As disclosed above, simultaneously to the operation of the impeller **44** by the impeller motor, the motors **42** rotate the movement belts **12** which rotate the two main brushes **14** and the auxiliary brush **15**. This provided to the robot **10** the ability to move and to clear the pool's surface by the brushes.

In addition to the ability of the robot **10** to clean the pool by its internal filtering system, the robot is able to clean the pool by using an external suction and filtering system, as it described below with reference to FIGS. **4** to **8**.

As shown in FIG. **4**, in order to clean the pool by an external suction and filtering system (not shown), which can be the filtering system of the pool (e.g., standard pool filtering systems, biological filtering system), or any other filtering system located outside the housing **20**, at the first step, the first and second covers **21** and **23** can be pivotally opened so as to extract the filter units **27** and **29** out of their filter compartment **26** and **28**, correspondingly. The connection of the robot **10** to the external suction and filtering system and its operation when connected to this system are detailed below.

Referring to FIGS. **5** and **6**, the first cover **21** of the housing top surface **24** comprises an additional inlet **72** and an additional outlet **74** which are disposed at a common opening **70** formed therein. The opening **70** can be opened and closed by a door **76**, which is shown in its closed position in FIGS. **1** and **2**, and in its opened position in FIGS. **5** and **6**.

The additional outlet **74** is used for pumping water with debris from an area underneath the housing bottom **22** to the external suction and filtering system. When the water with debris is received within the external suction and filtering system, it is filtered therein and clean water is returned to the pool.

In order to deliver and pump the water with debris to the external suction and filtering system, the first bottom inlet **32** is used for a second fluid communication with the additional outlet **74** via a second fluid path **52** (which is different from the first fluid path **51**). The second fluid path **52** constitutes a part of an external suction and filtering fluid path **54** which is created when the additional outlet **74** is fluidly connected to the external suction and filtering system.

Following the extraction of the filter units **27** and **29** from their filter compartments (shown in FIG. **4**), the door **76** is opened, and an adapter unit **80** (shown in FIGS. **6** and **7**) is inserted into the first filter compartment **26**. The adapted unit **80** has an interior portion which is configured to fluidly interconnect between the additional outlet **74** and the bottom inlet **32**, thereby constitute a part of the second fluid path **52**. When the second fluid path **52** is established by the adapter unit **80**, the first fluid path **51** has to be totally cancelled. Therefore, additionally to the extraction of the filter units **27** and **29** from their filter compartment, the second bottom inlet **34** has to be sealed so as to prevent entrance of water into the second filter compartment **28**. This sealing is performed by inserting a sealing member **35** (shown in FIGS. **6** and **8**) into the second bottom inlet **34**.

The reference to FIGS. **6** and **7**, the adapter unit **80** has a first end **84** and a second end **86** which are disposed at opposite ends of the interior portion **82**. When the adapter unit **80** is mounted within the first filter compartment **26**, its first end **84** is fluidly connected to the first bottom inlet **32**, and its second end **86** is fluidly connected to the additional outlet **74**. More specifically, the second end **86** of the adapter unit **80** is connected via the additional outlet **74** to a hose adapter **90** which fluidly interconnects between the second end **86** and a hose **92**. In operation, the hose **92** is connected to the external suction and filtering system for drawing water and debris from the first bottom inlet **32** to the external suction and filtering system via the adapted unit **80**. The hose adapter **90** includes a swivel mechanism **91** configured for preventing swivel of the hose **92** around itself.

When the external suction and filtering system is used, the robot still has to be proximal to the pool's surface (as when the internal filtering system is used) by using a thrust force in order to perform its intended cleaning operation of cleaning the pool's floor and to be able to climb on the pool's wall and cleaning it. For this task, when the adapted unit **80** is disposed within the first filter compartment, and the door **76** is opened, a third fluid communication is generated along a third fluid path **53** which is defined between the additional inlet **72** and the impeller outlet **30**. The third fluid path **53** is used for introducing water from the sides of the robot and extracting it via the impeller outlet **30**, thereby generating the thrust force that biases the robot **10** toward the surface of the pool. During operation, the impeller motor is operated for rotating the impeller **44** and the motors **12** are operated for rotating the tracks **12** which are responsible for the movement of the robot and rotation of its brushes **14** and **15**. This operation of the impeller **44** causes the water to be drawn into to robot via the third fluid path **53**. While the motors **42** are operated for moving the robot along the pool's surface, and the impeller motor is used for rotating the impeller **44** for generating the thrust force which keeps it proximal the pool's surface, the external suction and filtering system pumps water and debris via the second fluid path and filters it.

This simultaneous operation provides two opposite directions of fluid flow in the opening **70**: one fluid flow via additional outlet **74** towards the external suction and filtering system, and another opposite flow via the additional inlet **72**, disposed around the additional outlet **72**, into the interior of the robot. In should be mentioned that when the internal filtering system is used, the door **76** has to be closed for preventing entrance of water via the opening **70**, and when the external suction and filtering system is used, the door **70** has

to be opened for allowing the second and third fluid communications, thereby creating the second and the third fluid paths.

As explained above, the robot **10** is configured for cleaning a pool by used an internal of an external suction and filtering system. For choosing which filtering system will be used, the robot **10** has an arrangement that converts is operation between the internal and the external suction and filtering systems, thereby between the first fluid path and the second with the third fluid paths. In order to use the external suction and filtering system instead of the internal filtering system, the following steps have to be performed:

a. The filter units **27** and **29** have to be extracted from their filter compartments, and the second bottom inlet **34** has to be sealed, for cancelling the first fluid path **51**; and
b. The adapter unit **80** has to be accommodated within the first filter compartment **26** for defining the second and the third fluid paths **52** and **53** instead of the first fluid path **51**.

In order to use the internal filtering system instead of the external suction and filtering system, the following steps have to be performed:

a. The adapter unit **80** has to be extracted out of the first filter compartment **26** for cancelling the second and the third fluid paths **52** and **53**, and the second bottom inlet **34** has to be opened; and
b. The filter units **27** and **29** have to be accommodated within their filter compartments, so as to create the first fluid path **51**.

In both cases of using the internal filtering system or the external suction and filtering system, the motors of the robot, and/or its controller may not know which filtering system is used, because in both cases the motors of robot which are responsible with its movement and for the rotation of the impeller may continue to operate at the same manner indifferently which filtering system is used.

When the robot **10** is connected to the external suction and filtering system, its ability to provide passage of water with debris without passing through the impeller via the first fluid path, is an advantage due to the tendency of large debris to be stuck within the impeller and to risk its operation. Thus, the fact that second fluid path is not in fluid communication with the impeller, prevents this risk. Another advantageous feature of the robot of the presently disclosed subject matter is its ability the continue operating the impeller for generating a thrust force that biases the robot **10** toward the surface of the pool by using the third fluid path, independently and simultaneously to the passage of fluid with debris via the second fluid path to the external suction and filtering system. This operation of the impeller can, for example, ensure that the robot will not be disconnected from the wall of the pool when climbing on it.

Reference is now made to FIG. **9**, which schematically illustrates a holder **100** having configured for holding the electric cable **41** and the hose **92** in proximity to each other. A plurality of holders **100** can be used for holding the electric cable **41** and the hose **92** together. The holder **100** comprises: an aperture **105** configured for allowing insertion of the electric cable **41** therethrough and free rotation of this cable therein; and a grasper **110** configured for detachably attaching to the hose **92**. During movement of the robot within the pool, the hose **92** will no swivel within the grasper **110** due to the swivel mechanism **91** and a strong gripping of the hose **92** by the grasper **110**.

Reference is now made to FIG. **10** which schematically illustrates a pool cleaning robot, which is generally indicated at **210**. The robot **210** is configured to clean the pool by using an internal filtering system, as it is explained below. In addition to this ability, the robot is also configured to allow extraction of debris that is collected in the internal filtering system, by using an external suction and filtering system, as detailed below.

The robot **210** comprises a housing **220** which has a housing bottom **222** and a housing top surface **224** having a first cover **221** and a second cover **223**, and a driving unit **240** having an impeller **244** which is connected to an impeller motor (not shown) that rotates the impeller in operation.

The housing **220** also includes a first filter compartment **226** and a second filter compartment **228** formed therein, such that the driving unit **240** is disposed therebetween.

The driving unit **240** is sealably disposed within the housing **220**, and can be operated by being connected to an electric power source (not shown) via an electric cable **241**. The driving unit **240** also includes a main controller (not shown) which can be programmed to control the operation of the robot, and specifically the operation of the robot's motors. For example, the main controller can be programmed to perform scanning of the pool according to one of several algorithms.

As shown in FIG. **10**, each of the filter compartments **226** and **228** accommodates a first filter unit **227** and a second filter unit **229**, correspondingly. The first and the second filter units **227** and **229** constitute a part of the internal filtering system by filtering the pool's water which passes therethrough while being pumped by the impeller **244**. The filter units **227** and **229** are made of a rigid frame, and can be extracted from the robot **210** for cleaning, replacement, and for using the external suction and filtering system instead of the internal filtering system.

The housing **210** further includes an impeller outlet **230** which is formed in the housing top surface **224**, and a first and second bottom inlets **232** and **234** which are formed in the housing bottom **222**. As shown in FIG. **10**, the first and the second bottom inlets **232** and **234** are in fluid communication with the first and the second filter compartments **226** and **228**, and with the first and the second filter units **227** and **229**, correspondingly. In the configuration of the robot **210**, in which the internal filtering system is used, the first and the second bottom inlets **232** and **234** are in a first fluid communication with the impeller outlet **230** via the first and the second filter units **227** and **229**, correspondingly, thereby defining a first fluid path **251**.

During operation of the robot **210**, when the internal filtering system is used, the impeller **244** which is operated by the impeller motor, draws water and debris from the floor or sidewall of the pool via the first fluid path **251**, i.e., from the first and the second water inlets **232** and **234** through the first and the second filters **227** and **229** towards the impeller outlet **230**. The clean water is expelled through the impeller outlet **230**. In addition to facilitating the cleaning of the pool, this process generates a thrust force that biases the robot **210** toward the surface of the pool. This thrust force keeps the robot proximal to the pool's surface to as to clean the pool's floor and to climb on the pool's wall and clean it.

In addition to the above description of the robot's **220** operation for cleaning the pool by the internal filtering system, it can be fluidly connected to an external suction and filtering system for simultaneously and/or independently extracting the debris that is collected in the filter unit(s) of the internal filtering system. This operation of the external suction and filtering system can be used for emptying the filter unit(s) of the internal filtering system without extracting the robot **220** from the pool and without extracting the filter unit(s) from the robot in order to clean them. For providing this, the filter unit **227** has a filter unit interior **233** a part of

which constitutes a part of the first fluid path **251** and also a part of a second fluid path **252**. The second fluid path **252** is defined between the first bottom inlet **232**, the filter unit interior **233**, a filter unit opening **265**, an additional outlet **274**, a hose **292**, and an external suction and filtering system (not shown).

In order to empty the filter unit **227** from the debris collected therein, the second fluid path **252** can be established by opening a door **276**, connecting a hose adapter **279** to the filter unit opening **265** in the additional outlet **274**, and connecting the hose **292** to the hose adapter **279**. The hose adapter **279** includes a swivel mechanism **280** which is configured for preventing swivel of the hose **292** around itself. When the second fluid path **252** is established, the external suction and filtering system can be activated when needed for drawing the debris from the filter unit **227**. This operation of the external suction and filtering system can be performed simultaneously to the operation of the internal filtering system, and also when the internal filtering system is inoperative. In other words, according to one example of operation, the robot can clean the pool via the first fluid path while debris is extracted therefrom via the second fluid path by the external suction and filtering system, at the same time (in parallel). According to another example of operation, the robot can be in an inoperative state (non-cleaning state), while the debris is extracted therefrom via the second fluid path by the external suction and filtering system.

It should be emphasized that according to the example of FIG. **10** in which the first and the second fluid paths are established, the third fluid path which is disclosed above with reference to FIGS. **1** to **9**, is obstructed, so that there is no fluid communication between the additional inlet, and the impeller outlet that are defined above.

According to one example, the external suction and filtering system can be one integrated unit which collects the debris from the robot **10** by pumping it, filters the water from the debris, and return the filtered water to the pool. According to another example, the external suction and filtering system can be divided to two parts: a first part (e.g., a debris collecting bag) that collects the massive debris (e.g., leaves) from the filter unit(s) of the robot, and a second part that is responsible for the suction of the debris from the robot, and optionally filtration of the water and returning it to the pool.

The above described operation of the external suction and filtering system for emptying the filter unit of the robot **210** can be controlled by a timer (not shown) that is preprogrammed to be operated according to predetermined sequences of time.

The advantage of the above described ability to empty to robot's **210** filter unit(s) by the external suction and filtering system allows to leave the robot **210** in the pool for long periods of time (e.g., in the winter) without the need to extract it from the pool each time for cleaning its filter unit(s). This results in a much easier operation of the robot for cleaning its filter units.

Those skilled in the art to which this invention pertains will readily appreciate that the embodiments described above are only examples of the presently disclosed subject matter and that numerous changes, variations, and modifications can be made thereto.

The invention claimed is:

1. A pool cleaning robot comprising:

a housing having a housing bottom and a housing top surface;

an impeller and a motor configured to operate the impeller, both mounted within the housing;

a first filter compartment formed within said housing configured for accommodating a first filter unit therein;

an impeller outlet formed in said housing top surface;

a first additional outlet other than the impeller outlet formed in said housing top surface and configured for being fluidly connected to an external suction and filtering system;

a first bottom inlet formed in said housing bottom configured for a first fluid communication with the impeller outlet via said first filter unit, thereby defining a first fluid path;

a second bottom inlet formed in said housing bottom configured for a second fluid communication with said first additional outlet via a second fluid path at least partially different from the first fluid path, said second fluid path constituting a part of an external suction and filtering fluid path created when said additional outlet is fluidly connected to the external suction and filtering system;

a hose adapter configured for fluidly connecting said first additional outlet to a hose connectable to said external suction and filtering system;

wherein said pool cleaning robot is operated by an electric supply source via an electric cable, and comprises a holder configured for holding said electric cable and said hose in proximity to each other and preventing their swivel around each other;

wherein the holder comprises an aperture for allowing insertion of said electric cable therethrough and free rotation of said cable therein and a grasper configured for detachably attaching to said hose.

2. The pool cleaning robot according to claim **1**, wherein the pool cleaning robot further comprising an arrangement for selecting or mixing between the first fluid communication and the second fluid communication.

3. The pool cleaning robot according to claim **2**, wherein said second filter compartment is parallel to said first filter compartment.

4. The pool cleaning robot according to claim **3**, wherein said interior portion of the adapter unit is disposed between a first and a second end of the adapter unit, the first end of the adapter unit being configured for fluidly communicating with said second bottom inlet, and the second end of the adapter unit being configured for fluidly communicating with said first additional outlet.

5. The pool cleaning robot according to claim **2**, further comprising a main controller configured to control the operation of said motor during operation of the robot via the first fluid path, and during operation of the pool cleaning robot via a combination of the second and the third fluid paths.

6. The pool cleaning robot according to claim **1**, wherein the hose adapter includes a swivel mechanism configured for preventing swivel of said hose around itself.

7. The pool cleaning robot according to claim **1**, further comprising a second additional inlet formed in said housing top surface and configured for a third fluid communication with the impeller outlet, thereby defining a third fluid path.

8. The pool cleaning robot according to claim **7**, wherein said third fluid communication is configured to generate a thrust force that biases said housing toward a pool surface which the housing bottom faces during operation of the robot.

9. The pool cleaning robot according to claim **7**, wherein said pool cleaning robot is configured to be operated via at least one of the first, second and the third fluid communications.

10. The pool cleaning robot according to claim **9**, wherein said second additional inlet is configured for being opened and closed for allowing and preventing said third fluid communication, respectively.

11. The pool cleaning robot according to claim **7**, wherein said second additional inlet and second additional outlet are disposed at a common opening formed within the housing top surface.

12. The pool cleaning robot according to claim **11**, wherein said common opening comprises a door configured for allowing and preventing said second and third fluid communication by being opened and closed, correspondingly.

13. The pool cleaning robot according to claim **11**, wherein said second additional inlet is formed at said common opening around said second additional outlet.

14. The pool cleaning robot according to claim **7**, wherein said pool cleaning robot is configured for climbing of a sidewall of the pool during operation of the pool cleaning robot via the first fluid path, and during operation of the pool cleaning robot via a combination of the second and the third fluid paths, when the biasing contributes to the pool cleaning robot to be in contact with the sidewall of the pool.

15. The pool cleaning robot according to claim **1**, wherein said first fluid communication is additionally configured to generate a thrust force that biases said housing toward a pool surface which the housing bottom faces during operation of the robot.

16. The pool cleaning robot according to claim **1**, further comprising a driving unit having at least one electric motor configured for moving said pool cleaning robot within the pool.

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